ANTHROPOMETRIC INDICES AMONG U. S. NAVY SUBMARINERS

by

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ABSTRACT

As part of the Longitudinal Health Study conducted on a group of 1,017 U.S. Navy submariners eighteen anthropometric measurements were taken and are presented as statistical summaries. This information on the characteristics of submariner physical build can be incorporated into new designs for submarine equipment, e.g. consoles, berthing spaces, etc., and can also be used in future epidemiologic studies of submariner health.

SUMMARY PAGE

THE PROBLEMS

Anthropometry, the science of measuring the human body, is useful in describing a person's body build in order to design equipment and machine interfaces to match human body form. It can also be used in estimating body composition in terms of relative fat tissue and lean tissue masses. This body composition ratio (fat/lean) is considered to be an indicator of general health and performance capability.

No large investigation of U.S. Navy submariner anthropometry has been published. Data on anthropometric indices can contribute to the resolution of operational, engineering and medical problems confronting Navy submariners.

THE FINDINGS

Eighteen anthropometric indices obtained during the Longitudinal Health Survey from 1972 to 1977 have been analyzed from a cohort of 1017 submariners. These submariners represent the full spectrum of Naval submariner occupational categories. Statistical analysis is presented for each anthropometric index.

APPLICATION

This information can be applied to the design of submarines and equipment, to research into submariner performance, and to human factors research. It can also be incorporated into epidemiologic studies of submariner health, and can contribute toward the periodic evaluation of physical standards for military submarine personnel.

ADMINISTRATIVE INFORMATION

The initial data analysis of this work was supported by the Naval Medical Command, Navy Medical Research and Development Command Work Unit No. MR00001.01-5078. It was submitted for review on 16 Feb 1989, cleared for publication on 11 April 1989, and designated NSMRL Report No. 1135.

Military anthropometry has been extensively investigated among U.S. Army and Marine Corps male and female personnel (1-2) and Naval aviators (3). However, submariners have not been specifically characterized in terms of anthropometric indices.

From 1972-1978, the Naval Submarine Medical Research Laboratory, Groton, Connecticut conducted the initial phase of a Longitudinal Health Survey on a cohort of 1,017 U.S. Navy submariners. The survey collected physical and historical information on fourteen multiphasic health profiles obtained during the initial examination of each submariner. Anthropometry was included for several reasons. First, there had, up to that time, been no large-scale anthropometric studies published of U.S. Navy submariners, and other reports discussing associations between morbidity and physical characteristics considered few measures of body build or stature. Second, additional information on the characteristics of submariner build could be incorporated into new designs for submarine equipment, particularly, engineering and weapon system consoles, berthing spaces, passageways, and compartment hatches and protective equipment. Finally, data collected on submarine anthropometrics could be used in future epidemiologic studies of submariner health, to examine associations between anthropometry and risk of chronic diseases (e.g. coronary artery disease and diabetes mellitus), acute morbidity (e.g., musculoskeletal disorders such as low back pain), and other submarine-related physical problems.

METHOD

The Cohort

The 1972-1978 Longitudinal Health Survey has been described elsewhere (4-5). This cohort was a non-random sample, as all who volunteered were accepted into the study. The cohort was nevertheless considered representative of the total Navy submarine population, based on its distribution by rank, rate, and paygrade. The ages of the submariners were recorded as of their last birthday. The mean age of the total population was 28.04 years. The standard deviation was 5.90 years, giving a coefficient of variation of 21.0 percent. The distribution and statistical values of age are given in Table I.

The Measures

The eighteen anthropometric measures are given in Tables 2 to 19. They were recommended by Mr. Robert White of the U.S. Army Research Institute of Environmental Medicine, Natick, Mass. All measurements were taken by the same examiner, who was trained by White. Weight was recorded on spring scales (Detecto Model 419). Circumferences were measured with Swiss manufactured GPM anthropometers. Foot length was measured in a measuring box constructed at Naval Submarine Medical Research Laboratory. Skinfold thickness determinations were made with Lange MODEL skinfold calipers.

THE STATISTICAL PRODCEDURES

The statistical and computational procedures used in preparing this report are the same as those used in the analyses of the data from the 1966 survey of U.S. Army Soldiers by White, R.M., and Churchill, E. (2), from which, for purposes of comparability, the descriptions of the statistical procedures are taken.

The Standard Measures. The usefulness of any anthropometric survey depends in large measure on the extent to which the mass of data generated is translated by statistical analysis into summaries of value in the solution of design and related problems and which point up the important implications of the data.

The summary statistics provided here for each anthropometric variable are those which traditionally have been included in the U.S. Military anthropometric reports. Measures of skewness and kurtosis have been added to the list of summary statistics.

The statistical summaries have been chosen in the belief that they provide the simplest and most generally useful univariate summaries of the total data. As valuable as these statistics may prove to be, they contain only a small portion of the useful information embodied in the survey data.

The means, standard deviations, standard errors are listed in both metric and English unit limits. The statistics are given first (to the left of the statistics name in the tables) in the type of units in which the data were measured and then in the converted units. The interval in the frequency tables follow the same order.

RESULTS AND DISCUSSION

Tables 2-19 give the detailed findings. They are presented in a descriptive format and can serve as a reference for interested personnel in the fields of human factors, clothing and uniform design, submarine medicine, environmental physiology, submarine equipment design, Naval submarine operations, and epidemiology.

This information can be of assistance in the design of submarines and equipment. It can also characterize population of submariners on the basis of body build and limb dimensions, and on the amounts of subcutaneous fat at various body sites. This latter information can be used in epidemiologic studies which try to relate risk for certain diseases and occupational injuries to multiphase health variables. Results from these studies can also be incorporated into defining standards for physical qualification for submariners.

Measures of Skewness $\frac{\Sigma (X - \bar{X})^3}{N \cdot SD^3}$ and Kurtosis $\frac{\Sigma (x - \bar{x})^4}{N \cdot SD^4}$

have been added to the list of summary statistics to provide a basis for judging the level of agreement between the normal distribution and the active distribution of the data, and a frequency distribution of each variable is also presented.

REFERENCES

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5. Tansey, WA. The Longitudinal Health Study: A Multiphasic Medical Surveillance Program for U.S. Navy Submarine and Diving Personnel. Naval Submarine Medical Research Laboratory Report No. 786. Groton, CT, May 1974.

ACKNOWLEDGMENTS

The authors thank Mrs. J. McNary for preparing the manuscript and Mr. Harry Fiske for his technical illustrations.

TABLE 1

SUBMARINER ANTHROPOMETRICS

AGE

N = 1016

The Percentiles

Years	%ile
42	99th
41	98th
40	97th
39	95th
37	90th
35	85th
34	80th
33	75th
32	70th
30	65th
30	60th
29	55th
28	50th
27	45th
26	40th
25	35th
25	30th
24	25th
23	20th
22	15th
21	10th
21	5th
20	3rd
20	2nd
20	1st

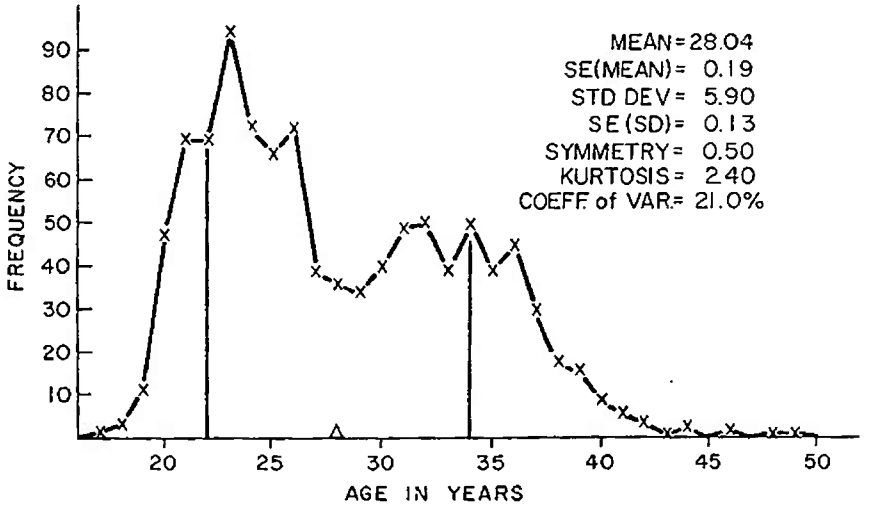


Table 2

WEIGHT

Subject is weighed while wearing only undershorts. The unit of measures is kilograms.

N = 1016

The Percentiles

Kilograms	%ile	Pounds
118.35	99th	260.91
112.04	98th	247.01
108.41	97th	239.01
103.88	95th	229.01
97.66	90th	215.01
93.87	85th	206.96
91.08	80th	200.79
88.77	75th	195.70
86.78	70th	195.70
85.00	65th	191.33
83.36	60th	183.77
81.80	55th	180.33
80.29	50th	177.00
78.80	45th	173.72
77.32	40th	170.47
75.82	35th	167.15
74.26	30th	163.71
72.60	25th	160.05
70.77	20th	156.03
68.71	15th	151.48
66.19	10th	145.93
63.33	5th	139.61
60.59	3rd	133.57
59.17	2nd	130.44
57.19	1st	126.08

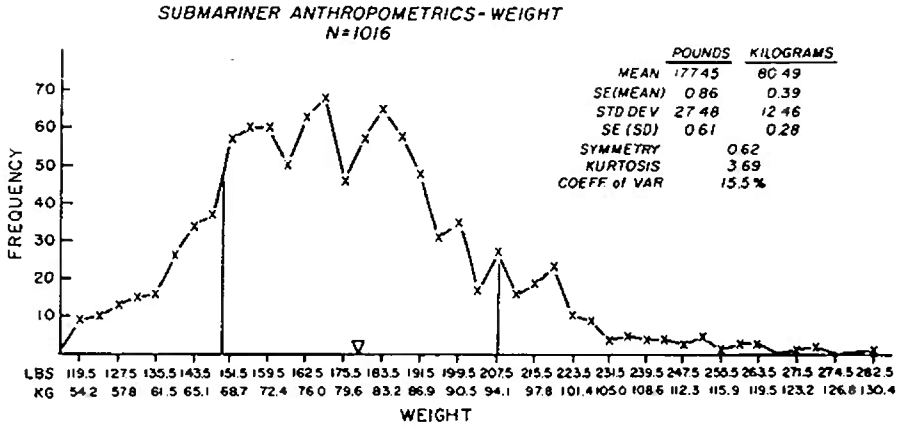
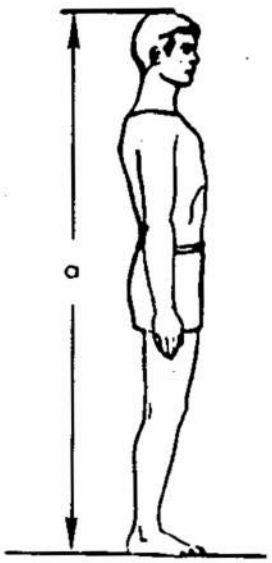


Table 3

STATURE

Subject stands erect, with heels, together and head level. Height is measured as the vertical distance from the top of the head (vertical). The unit of measure is centimeters.



a. Stature

N = 1017

The Percentiles

Centimeters	%ile	Inches
194.19	99th	76.45
191.74	99th	75.49
190.32	97th	74.92
188.49	95th	74.21
185.91	90th	73.19
184.91	90th	72.54
182.98	85th	72.04
181.88	75th	71.61
180.91	70th	71.22
179.15	65th	70.87
178.31	60th	70.53
177.48	55th	70.20
176.64	50th	69.87
175.79	45th	69.54
174.90	40th	69.21
173.95	30th	68.86
172.92	25th	68.08
171.76	20th	67.62
170.42	15th	67.10
168.74	10th	66.43
166.65	5th	65.61
164.82	3rd	64.89
163.78	2nd	64.48
162.30	1st	63.90

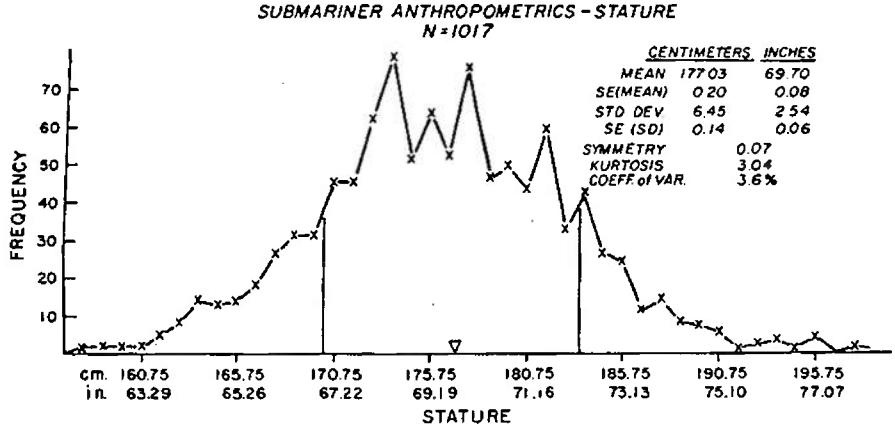
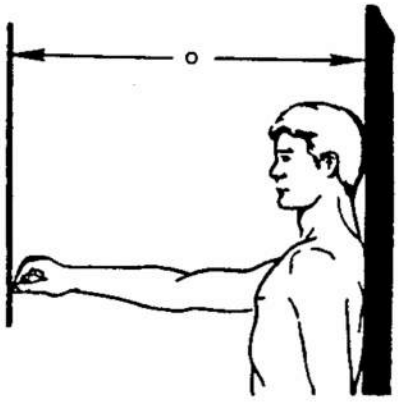


Table 4

SUBMARINER ANTHROPOMETRICS

FUNCTIONAL REACH

Subject stands erect against a wall, with his scapulae touching the wall. His right arm is extended forward horizontally, with the tips of his thumb and index fingers pressed together. Functional reach is measured as the horizontal distance from the wall to the outer edge of the junction of the tips of the thumb and index fingers. The unit of measure is centimeters.



o. Functional Reach

The Percentiles

Centimeters	%ile	Inches
89.75	99th	35.33
88.45	98th	34.82
87.61	97th	34.49
86.47	95th	34.03
84.70	90th	33.35
83.52	85th	32.88
82.60	80th	32.52
82.81	75th	32.21
81.14	70th	31.94
80.51	65th	31.70
79.92	60th	31.47
79.36	55th	31.25
78.82	50th	31.03
78.28	45th	30.82
77.74	40th	30.60
77.18	35th	30.39
76.60	30th	30.39
75.98	25th	30.16
75.29	20th	29.91
74.48	15th	29.92
73.46	10th	28.92
72.11	5th	28.39
70.82	3rd	27.88
69.99	2nd	27.56
68.61	1st	27.01

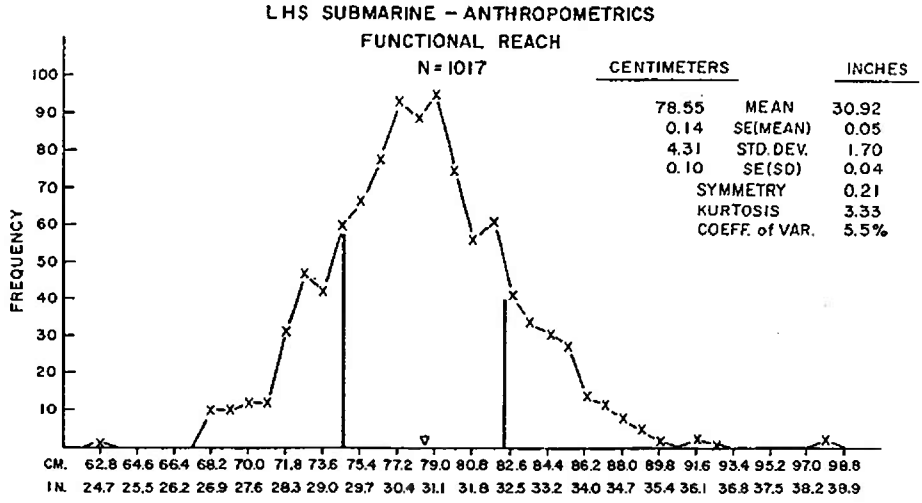
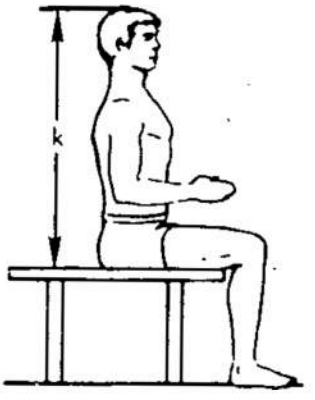


TABLE 5

SUBMARINER ANTHROPOMETRICS

SITTING HEIGHT

Subject sits erect with head level and with feet resting on the floor. The seat is adjusted so that his knees are bent at right angles. Sitting height is measured as the vertical distance from the sitting surface to the top of the head (vertex). The unit of measure is centimeters.



k. Sitting Height

N = 1017

The Percentiles

Centimeters	%ile	Inches
100.35	99th	39.51
99.43	98th	39.15
98.86	97th	38.92
98.11	95th	38.62
96.95	90th	38.17
96.17	85th	37.86
95.54	80th	37.61
94.94	75th	37.40
94.49	70th	37.20
94.02	65th	37.02
93.57	60th	36.84
93.12	55th	36.66
92.68	50th	36.49
92.23	45th	36.31
91.76	40th	36.13
91.28	35th	36.13
90.76	30th	35.49
90.18	25th	35.73
89.54	20th	35.51
88.78	15th	35.25
87.80	10th	34.95
86.52	5th	34.06
85.40	3rd	33.62
84.71	2nd	33.35
83.65	1st	32.93

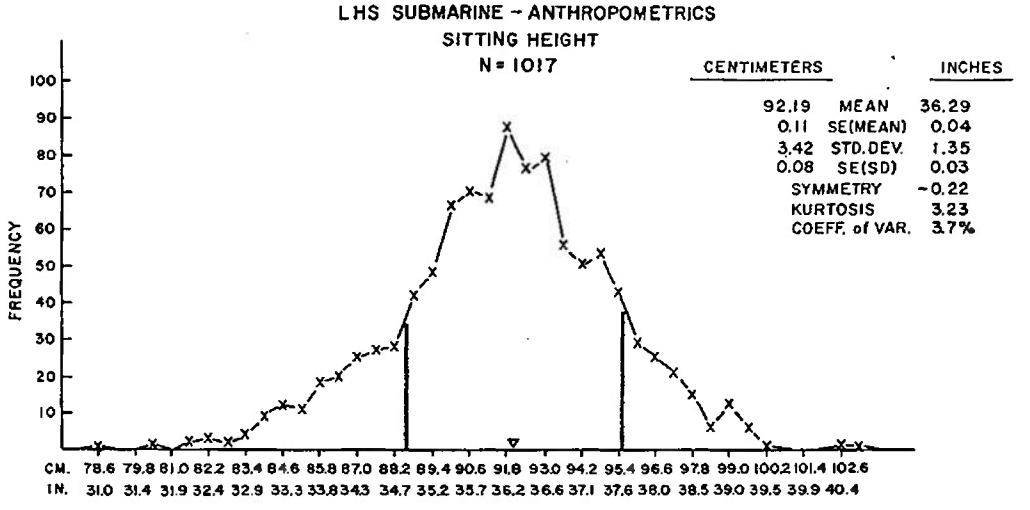
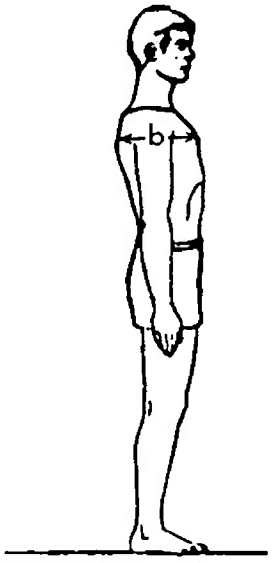


TABLE 6

SUBMARINER ANTHROPOMETRICS

CHEST DEPTH

Subject stands erect with his arms initially raised and then lowered after the anthropometer is in place under the right arm. The depth of the chest is measured at the level of the nipples during normal breathing. The unit of measure is centimeters.



b. Chest Depth

N = 1017

The Percentiles

Centimeters	%ile	Inches
30.67	99th	12.07
29.82	98th	11.74
29.31	97th	11.54
28.65	95th	11.28
27.69	90th	10.90
27.07	85th	10.66
26.59	80th	10.47
26.18	75th	10.31
25.82	70th	10.17
25.49	65th	10.04
25.18	60th	9.91
24.88	55th	9.80
24.59	50th	9.68
24.29	45th	9.56
24.00	40th	9.45
23.69	35th	9.33
23.37	30th	9.20
23.03	25th	9.07
22.64	20th	8.91
22.20	15th	8.74
21.64	10th	8.52
20.95	5th	8.25
20.31	3rd	8.00
19.95	2nd	7.85
19.39	1st	7.63

LHS SUBMARINE-ANTHROPOMETRICS

CHEST DEPTH

N = 1017

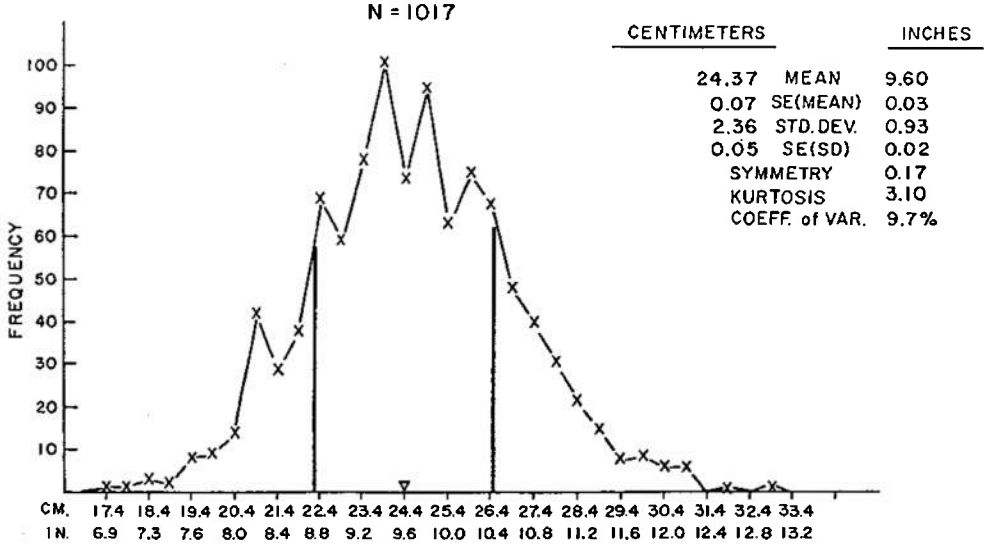
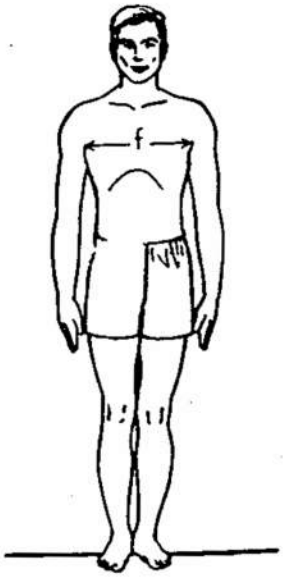


TABLE 7

SUBMARINER ANTHROPOMETRICS

CHEST BREADTH

Subject stands erect with his arm initially raised and then lowered after the anthropometer is in place. The breadth of the chest is measured at the level of the nipples during normal breathing. The unit of measure is centimeters.



f. Chest Breadth

The Percentiles

Centimeters	%ile	Inches
41.40	99th	16.30
40.55	98th	15.97
40.00	97th	15.75
39.26	95th	15.01
38.12	90th	15.46
37.36	85th	14.71
36.77	80th	14.48
36.27	75th	14.28
35.82	70th	14.10
35.42	65th	13.95
35.04	60th	13.80
34.69	55th	13.66
34.34	50th	13.52
33.99	45th	13.38
33.65	40th	13.25
33.30	35th	13.11
32.94	30th	13.97
32.55	25th	12.81
32.12	20th	12.65
31.64	15th	12.46
31.03	10th	12.22
30.29	5th	11.93
29.58	3rd	11.64
29.15	2nd	11.48
28.47	1st	11.21

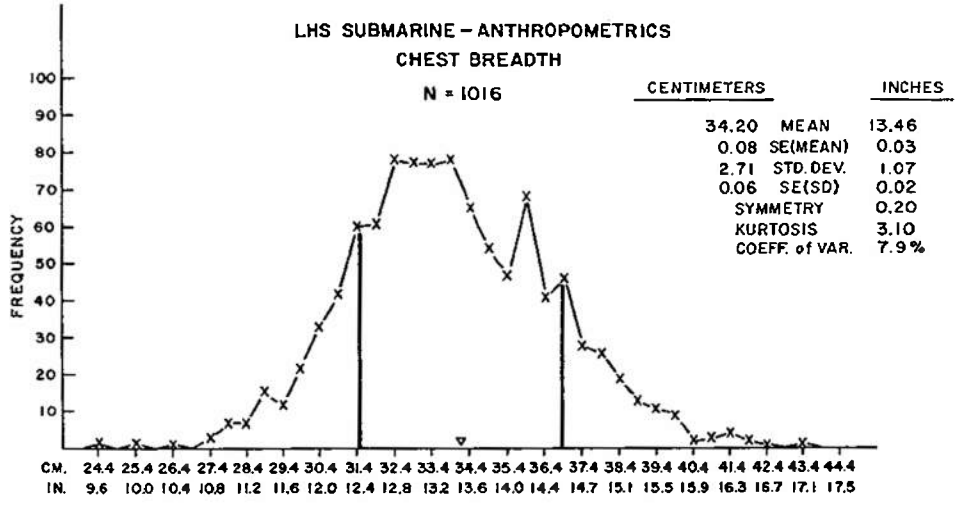


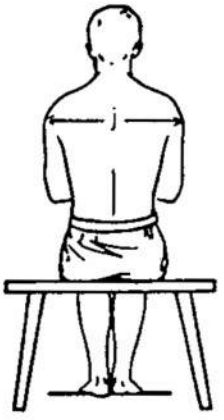
TABLE 8

SUBMARINER ANTHROPOMETRICS

SHOULDER BREADTH

Subject sits erect with his arms bent to form right angles at the elbows and with his elbows held against the body. The maximum breadth across the shoulders is measured at the level of the bulges of the deltoid muscles in the upper arms. The unit of measure is centimeters.

N = 1017



J. Shoulder Breadth
(Bideltoid Breadth)

The Percentiles

Centimeters	%ile	Inches
55.43	99th	21.79
54.38	98th	21.41
53.78	97th	21.17
52.99	95th	20.86
51.80	90th	20.40
51.04	85th	20.09
50.45	80th	19.86
49.96	75th	19.67
49.53	70th	19.50
49.14	65th	19.35
48.78	60th	19.21
48.44	55th	19.07
48.11	50th	18.94
47.78	45th	18.81
47.45	40th	18.68
47.12	35th	18.55
46.77	30th	18.42
46.40	25th	18.27
45.99	20th	18.11
45.51	15th	17.92
44.91	10th	17.68
44.13	5th	17.37
43.36	3rd	17.07
42.88	2nd	16.88
42.09	1st	16.57

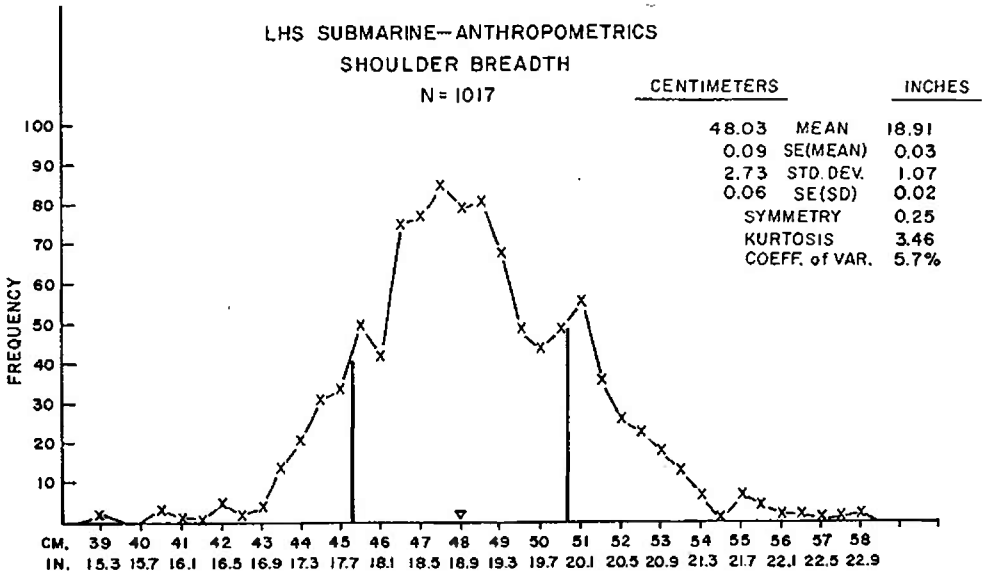
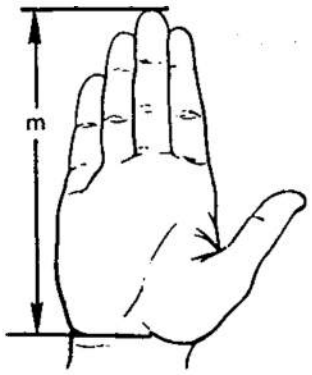


TABLE 9

SUBMARINER ANTHROPOMETRICS

HAND LENGTH

Subject sits with his right hand and fingers extended and palm p. The length of the right hand is measured from the wrist crease to the tip of the middle finger. The unit of measure is centimeters.



m. Hand Length

The Percentiles

Centimeters	%ile	Inches
21.17	99th	8.34
20.98	98th	8.26
20.85	97th	8.21
20.65	95th	8.13
20.32	90th	8.00
20.10	85th	7.91
19.91	80th	7.84
19.76	75th	7.78
19.61	70th	7.72
19.49	65th	7.67
19.36	60th	7.62
19.25	55th	7.58
19.13	50th	7.53
19.02	45th	7.49
18.91	40th	7.44
18.79	35th	7.40
18.67	30th	7.35
18.55	25th	7.30
18.41	20th	7.25
18.24	15th	7.18
18.04	10th	7.10
17.78	5th	7.00
17.53	3rd	6.90
17.37	2nd	6.84
17.10	1st	6.73

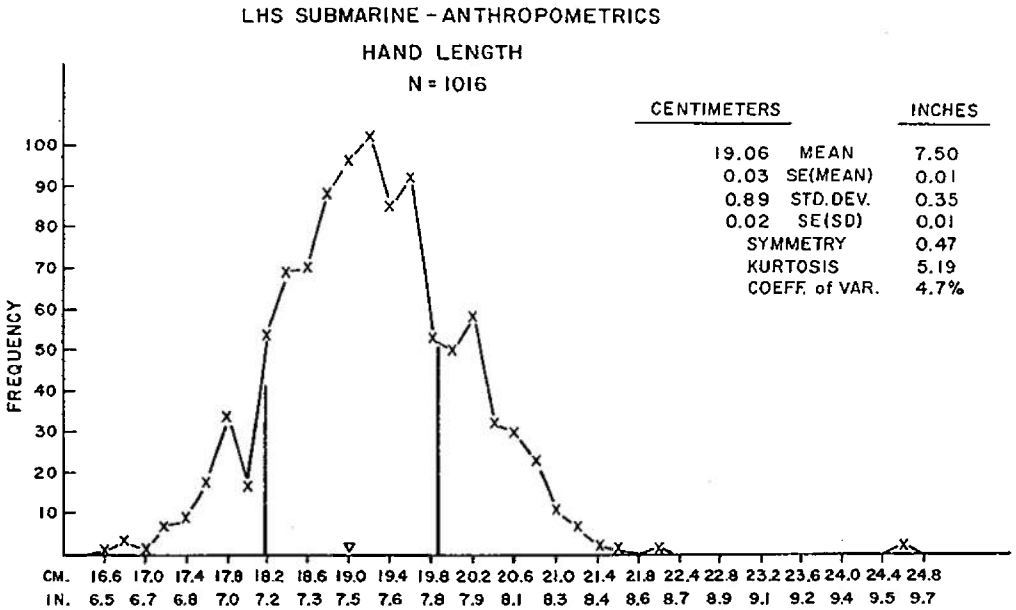
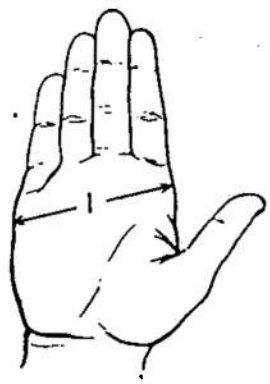


TABLE 10

SUBMARINER ANTHROPOMETRICS

HAND BREADTH

Subject sits with his right hand and fingers extended and palm up. The breadth of the hand is measured at the level of the knuckles (distal ends of the metacarpal bones). The unit of measure is centrimeters.



1. Hand Breadth

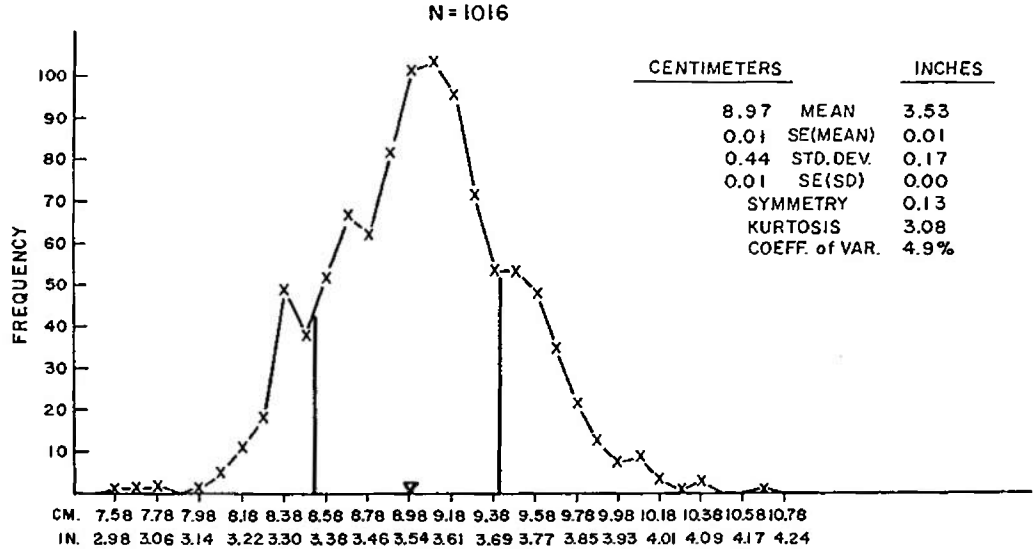
The Percentiles

Centimeters	%ile	Inches
10.12	99th	3.98
9.98	98th	3.93
9.89	97th	3.89
9.77	95th	3.85
9.60	90th	3.78
9.48	85th	3.73
9.40	80th	3.70
9.32	75th	3.67
9.25	70th	3.64
9.19	65th	3.62
9.13	60th	3.59
9.07	55th	3.57
9.01	50th	3.55
8.95	45th	3.53
8.90	40th	3.50
8.84	35th	3.48
8.78	30th	3.46
8.71	25th	3.43
8.64	20th	3.40
8.55	15th	3.37
8.45	10th	3.33
8.33	5th	3.28
8.22	3rd	3.24
8.16	2nd	3.21
8.08	1st	3.18

LHS SUBMARINE - ANTHROPOMETRICS

HAND BREADTH

N = 1016



CENTIMETERS		INCHES
8.97	MEAN	3.53
0.01	SE(MEAN)	0.01
0.44	STD.DEV.	0.17
0.01	SE(SD)	0.00
	SYMMETRY	0.13
	KURTOSIS	3.08
	COEFF. of VAR.	4.9%

TABLE 11

SUBMARINER ANTHROPOMETRICS

FOOT LENGTH

Subject stands erect with his weight evenly distributed on both feet. The maximum length of the right foot is measured from the back of the heel to the tip of the longest toe. The unit of measure is centrimeters.

n. Foot Length

N = 1017

The Percentiles

Centimeters	%ile	Inches
29.73	99th	11.70
29.41	98th	11.58
29.21	97th	11.50
28.94	95th	11.39
28.50	90th	11.22
28.10	85th	11.10
27.96	80th	11.01
27.75	75th	10.93
27.56	70th	10.85
27.38	65th	10.78
27.21	60th	10.71
27.05	55th	10.65
26.88	50th	10.58
26.72	45th	10.52
26.55	40th	10.45
26.38	35th	10.39
26.20	30th	10.31
26.00	25th	10.24
25.78	20th	10.15
25.53	15th	10.05
25.21	10th	9.93
24.83	5th	9.78
24.50	3rd	9.65
24.31	2nd	9.57
24.04	1st	9.47

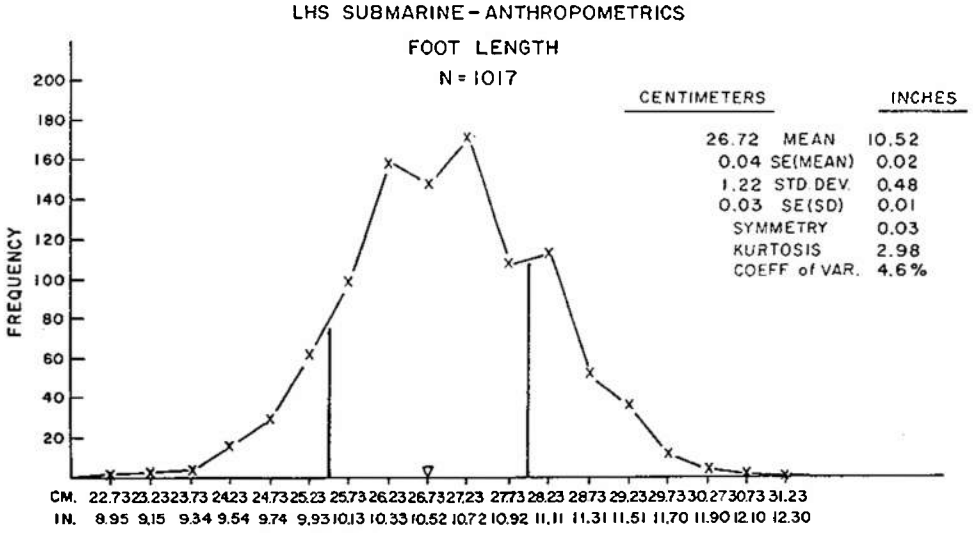
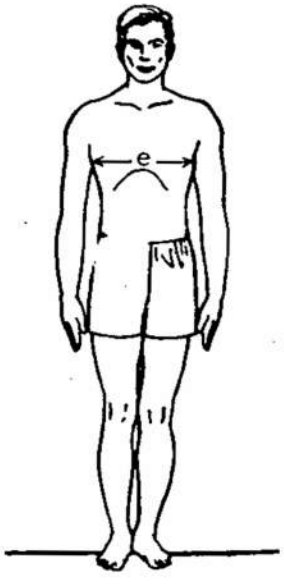


TABLE 12

SUBMARINER ANTHROPOMETRICS

CHEST CIRCUMFERENCE - INSPIRATION

Subject stands erect with his arms initially raised and then lowered after the tape is in place. The maximum horizontal circumference of the chest is measured at the level of the nipples at full inspiration. The unit of measure is centimeters.



e. Chest Circumference Inspiration

The Percentiles

Centimeters	%ile	Inches
123.76	99th	48.72
120.67	98th	47.51
118.66	97th	46.80
116.56	95th	45.89
113.30	90th	44.61
111.25	85th	43.80
109.69	80th	43.18
108.38	75th	42.67
107.22	70th	42.21
106.18	65th	41.80
105.19	60th	41.41
104.25	55th	41.04
103.33	50th	40.68
102.41	45th	40.32
101.49	40th	39.96
100.55	35th	39.59
99.56	30th	39.20
98.50	25th	38.78
97.33	20th	38.32
96.01	15th	37.80
94.38	10th	37.80
92.49	5th	37.16
90.76	3rd	35.73
89.85	2nd	35.37
88.59	1st	34.88

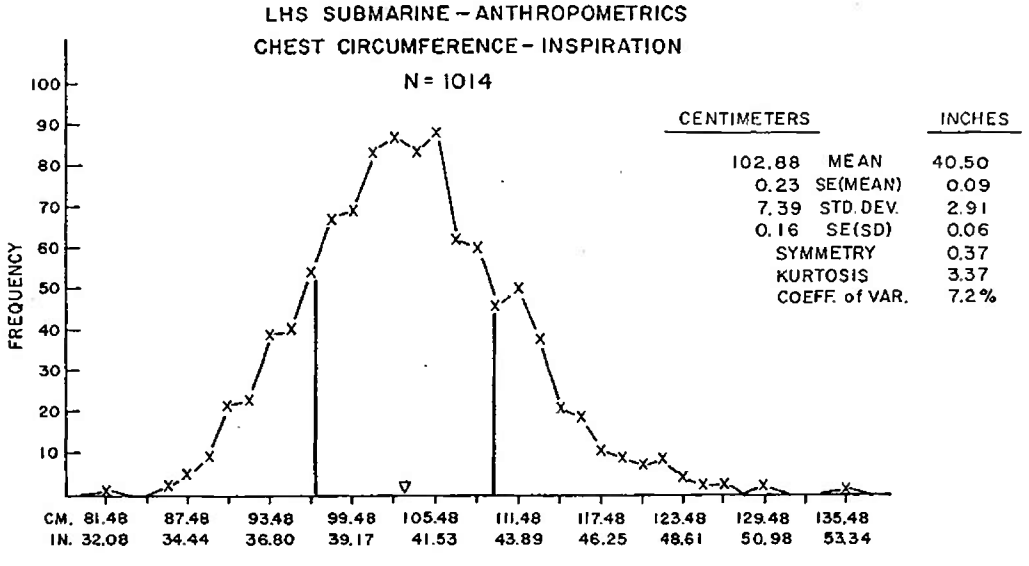
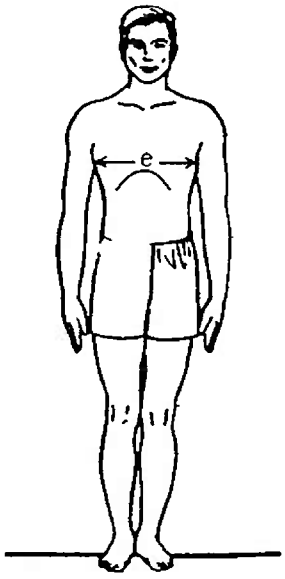


TABLE 13

SUBMARINER ANTHROPOMETRICS

CHEST CIRCUMFERENCE - EXPIRATION

Subject stands erect with his arms initially raised and then lowered after the tape is in place. The maximum horizontal circumference of the chest is measured at the level of the nipples at full expiration. The unit of measure is centimeters.



e. Chest Circumference Expiration

The Percentiles

Centimeters	%ile	Inches
117.42	99th	46.23
115.04	98th	45.29
113.49	97th	44.68
111.34	95th	43.83
108.01	90th	42.52
105.77	85th	41.64
104.03	80th	40.96
102.54	75th	40.37
101.24	70th	39.86
100.05	65th	39.39
98.94	60th	38.95
97.89	55th	38.54
96.87	50th	38.14
95.86	45th	37.74
94.87	40th	37.35
93.87	35th	36.96
92.84	30th	36.55
91.75	25th	36.12
90.57	20th	35.66
89.24	15th	35.13
87.63	10th	34.50
85.75	5th	33.76
83.92	3rd	33.04
82.89	2nd	33.64
81.29	1st	32.00

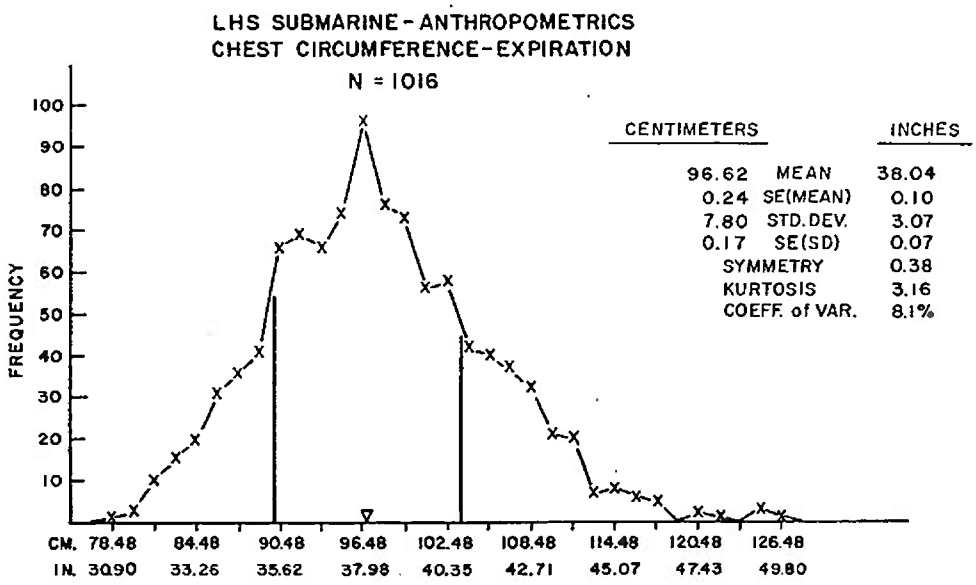
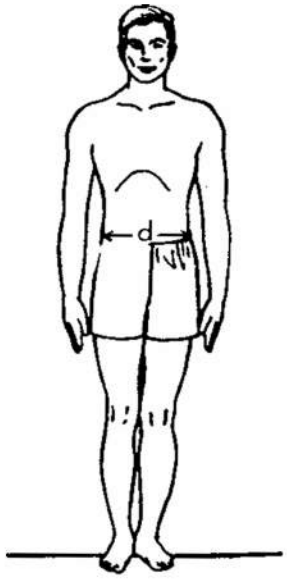


TABLE 14

SUBMARINER ANTHROPOMETRICS

ABDOMINAL CIRCUMFERENCE

Subject stands erect with abdomen relaxed. The maximum horizontal circumference of the waist is measured at the level of the umbilicus. The unit of measure is centimeters.



d. Waist Circumference

The Percentiles

Centimeters	%ile	Inches
117.45	99th	46.24
113.88	98th	44.83
111.66	97th	43.96
108.71	95th	42.80
104.32	90th	41.07
101.45	85th	39.94
99.24	80th	39.07
97.36	75th	38.33
95.71	70th	37.68
94.21	65th	37.09
92.80	60th	36.54
91.47	55th	36.01
90.17	50th	35.50
88.89	45th	34.99
87.61	40th	34.49
86.32	35th	33.98
84.97	30th	33.45
83.55	25th	32.89
81.99	20th	32.28
80.24	15th	31.59
78.11	10th	30.75
75.64	5th	29.78
73.31	3rd	28.96
72.04	2nd	28.36
70.16	1st	27.62

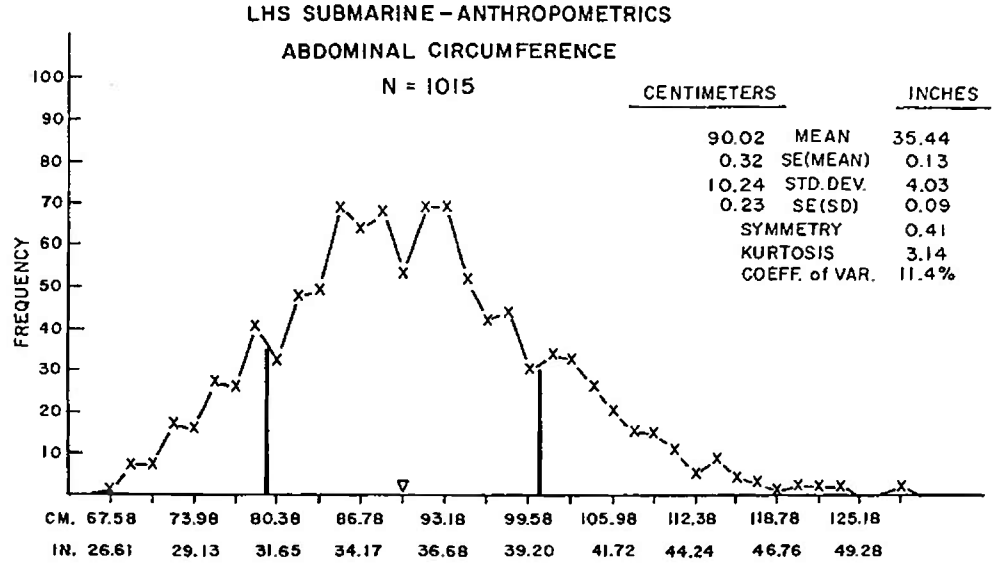
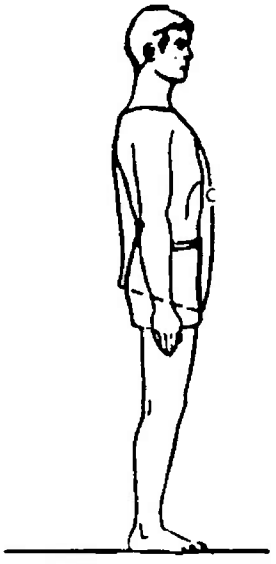


TABLE 15

SUBMARINER ANTHROPOMETRICS

VERTICAL TRUNK CIRCUMFERENCE

Subject stands erect with his feet slightly apart. The vertical circumference of the trunk is measured with a steel tape passed through the crotch, to the right of the scrotum, and then over the midpoints of the right shoulder and right buttock. The unit of measure is centimeters.



c. Vertical Trunk Circumference (Standing)

The Percentiles

Centimeters	%ile	Inches
188.23	99th	74.11
184.23	98th	72.55
182.03	97th	71.66
179.23	95th	70.56
175.41	90th	69.06
173.08	85th	68.14
171.35	80th	67.46
169.91	75th	66.89
168.65	70th	66.40
167.51	65th	65.95
166.44	60th	65.53
165.41	55th	65.12
164.40	50th	64.73
163.39	45th	64.33
162.37	40th	63.92
161.31	35th	63.51
160.18	30th	63.06
158.95	25th	62.58
175.56	20th	62.03
155.94	15th	61.03
153.86	10th	60.58
151.20	5th	59.53
148.74	3rd	58.56
147.27	2nd	57.98
145.02	1st	57.09

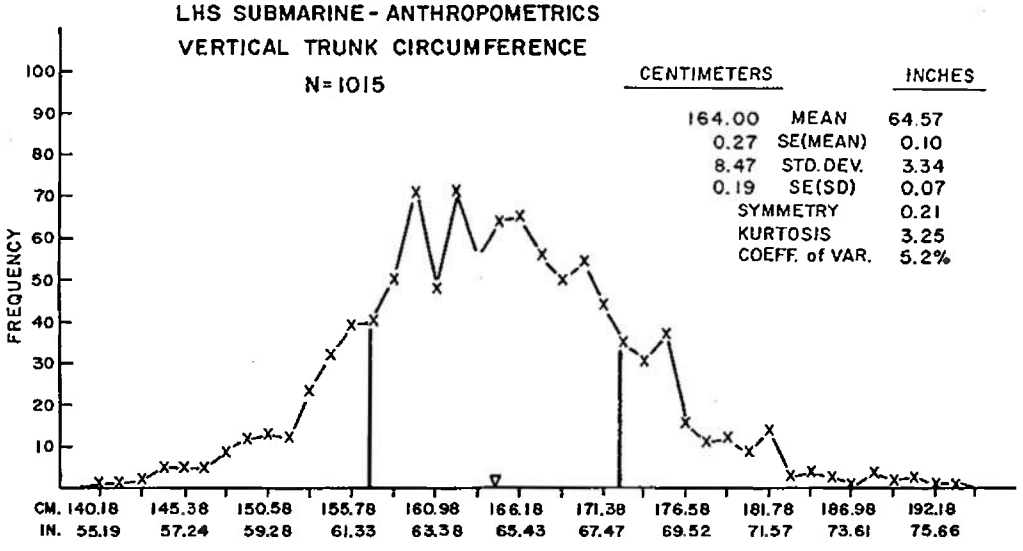
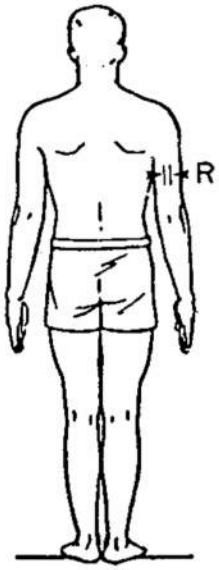


TABLE 16

SUBMARINER ANTHROPOMETRICS

TRICEPS SKINFOLD THICKNESS

The skinfold is picked up on the dorsum of the right arm, at a point midway between the acromial process of the scapula and the tip of the olecranon. Measurement is made with the forearm flexed to 90° and the arm pendant. The unit of measure is millimeters.



R. Triceps Skinfold

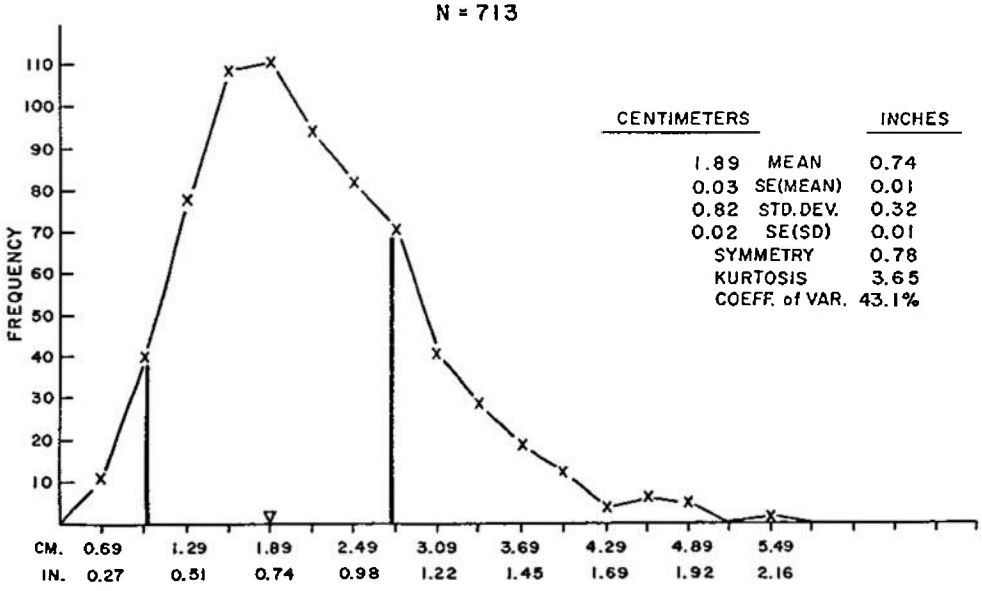
The Percentiles

Millimeters	%ile	Inches
4.35	99th	1.71
3.98	98th	1.57
3.76	97th	1.48
3.47	95th	1.37
3.05	90th	1.20
2.78	85th	1.10
2.59	80th	1.02
2.42	75th	0.95
2.28	70th	0.90
2.15	65th	0.85
2.04	60th	0.80
1.93	55th	0.76
1.83	50th	0.72
1.73	45th	0.68
1.63	40th	0.64
1.54	35th	0.60
1.44	30th	0.57
1.34	25th	0.53
1.23	20th	0.49
1.12	15th	0.44
0.99	10th	0.39
0.85	5th	0.34
0.72	3rd	0.28
0.65	2nd	0.26
0.57	1st	0.22

LHS SUBMARINE-ANTHROPOMETRICS

TRICEPS SKINFOLD THICKNESS

N = 713



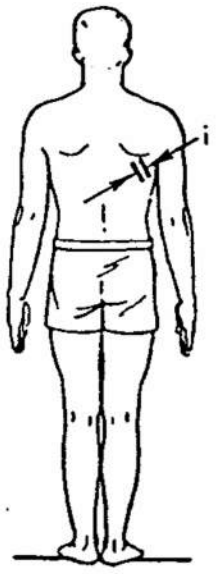
CENTIMETERS		INCHES
1.89	MEAN	0.74
0.03	SE(MEAN)	0.01
0.82	STD.DEV.	0.32
0.02	SE(SD)	0.01
	SYMMETRY	0.78
	KURTOSIS	3.65
	COEFF. of VAR.	43.1%

TABLE 17

SUBMARINER ANTHROPOMETRICS

SUBSCAPULER SKINFOLD THICKNESS

The skinfold is picked up under the angle of the right scapula. The fold is pointing slightly downward and outward. The unit of measure is millimeters.



i. Subscapular Skinfold

The Percentiles

Millimeters	%ile	Inches
4.72	99th	1.86
4.43	98th	1.74
4.24	97th	1.67
3.97	95th	1.56
3.55	90th	1.40
3.26	85th	1.28
3.04	80th	1.20
2.85	75th	1.12
2.68	70th	1.05
2.52	65th	0.99
2.38	60th	0.94
2.24	55th	0.88
2.11	50th	0.83
1.98	45th	0.78
1.86	40th	0.73
1.73	35th	0.68
1.61	30th	0.63
1.48	25th	0.58
1.34	20th	0.53
1.20	15th	0.47
1.05	10th	0.41
0.92	5th	0.36
0.80	3rd	0.32
0.77	2nd	0.30
0.76	1st	0.30

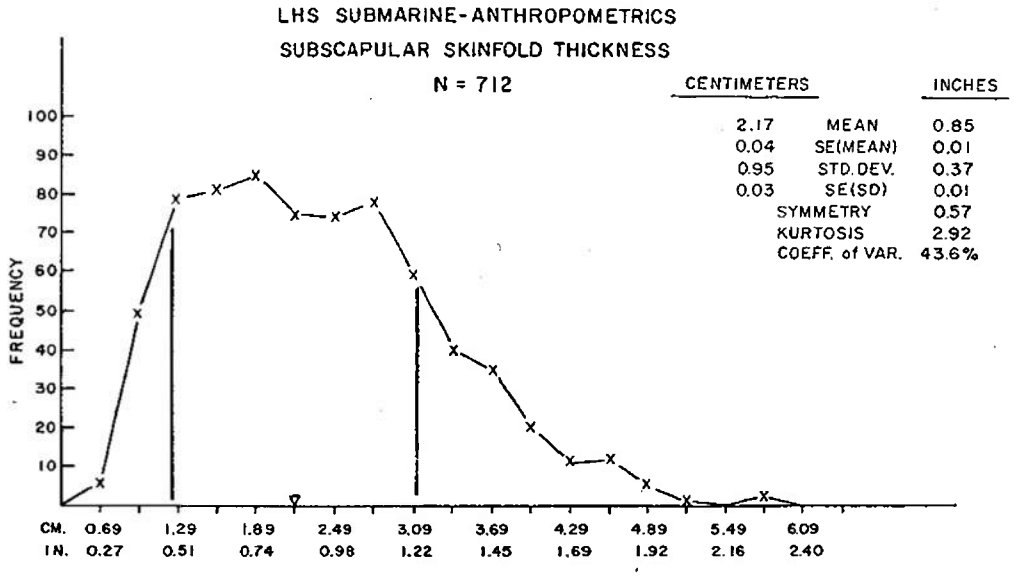
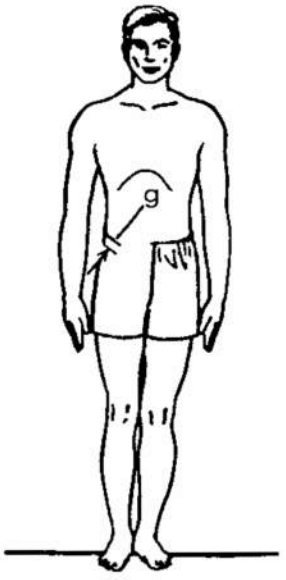


TABLE 18

SUBMARINER ANTHROPOMETRICS

MIDAXILLARY SKINFOLD THICKNESS

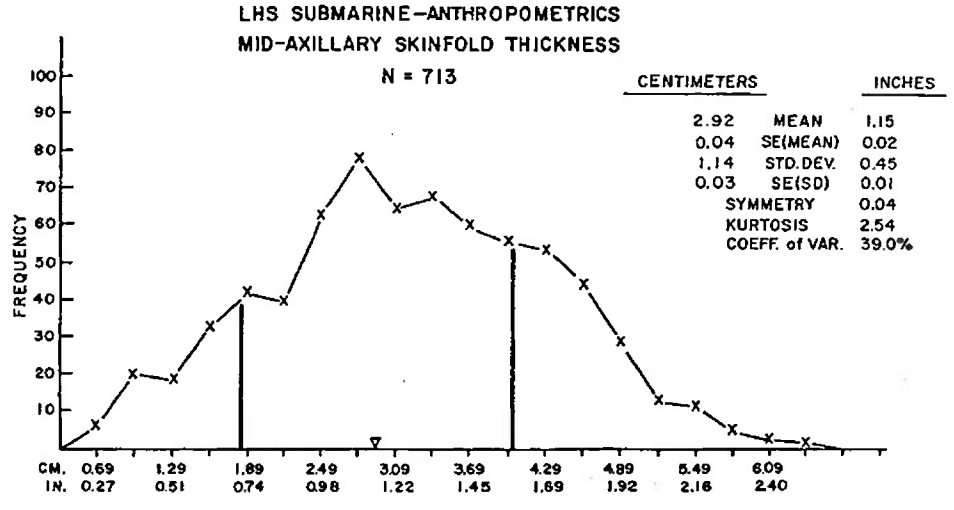
The skinfold is picked up one centimeter above and two centimeters medial to the right anterior superior iliac spine. The unit of measure is millimeters.



g. Suprailiac (Midaxillary) Skinfold

The Percentiles

Millimeters	%ile	Inches
5.52	99th	2.18
5.25	98th	2.07
5.08	97th	2.00
4.85	95th	1.91
4.47	90th	1.76
4.21	85th	1.66
3.99	80th	1.57
3.80	75th	1.50
3.63	70th	1.43
3.46	65th	1.36
3.30	60th	1.30
3.14	55th	1.24
2.98	50th	1.17
2.82	45th	1.11
2.66	40th	1.05
2.50	35th	0.98
2.32	30th	0.91
2.13	25th	0.84
1.92	20th	0.76
1.69	15th	0.66
1.41	10th	0.55
1.10	5th	0.43
0.85	3rd	0.34
0.74	2nd	0.29
0.62	1st	0.15



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As part of the Longitudinal Health Study conducted on a group of 1,017 U.S. Navy submariners eighteen anthropometric measurements were taken and are presented as statistical summaries. This information on the characteristics of submariner physical build can be incorporated into new designs for submarine equipment, e.g. consoles, berthing spaces, etc., and can also be used in future epideniologic studies of submariner health.

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